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Wind Energy Program Technology Portfolio

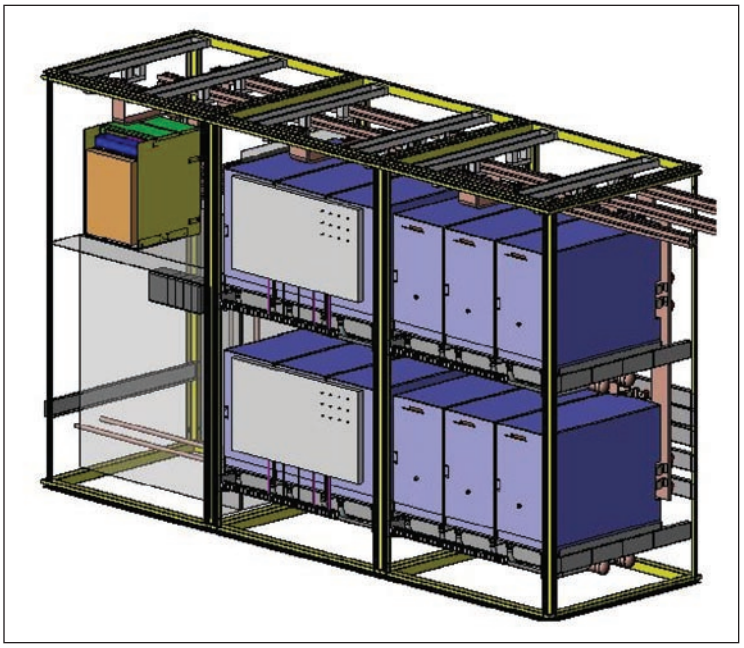
Low Wind Speed Technology Phase I: Advanced Power Electronics for Low Wind Speed Turbine Applications

Northern Power Systems, Inc.

Project Description: As wind turbine ratings, gear ratios, and torque levels get larger, the challenges in designing a reliable turbine gearbox increase. A direct-drive turbine equipped with a low-speed permanent magnet (PM) generator is a design that shows promise for megawatt-class wind turbines. By eliminating the gearbox, turbine manufacturers will eliminate the gearbox problems that cause a significant portion of documented turbine downtime and premature failure.

The generator in a direct-drive wind turbine must operate at very slow rotational speeds, generally less that 20 rpm for megawatt-class designs. The PM generator is a simple design approach that, until recently, was not cost effective because of the magnetic properties of fero-magnets. The cost of high-energy neodymium iron boron (NdFeB) magnets limited their use to small high-speed machine applications requiring relatively small amounts of magnetic material. The substantial decrease in magnet cost over the past few years and technical advances in generator design have made low-speed megawatt-class PM generators commercially practical.

A successful direct-drive turbine design must incorporate full power conversion through an advanced power converter to allow reliable variable-speed operation. This project explores a range of circuit topologies that are optimized for operation with a direct-drive PM generator. After issues such as efficiency, maintainability, reliability, and initial cost have undergone careful examination, a final circuit design will be selected, built, and tested with a 1.5-MW or larger direct-drive PM generator.



Concept illustration of an NPS advanced power converter.

Project Type: Component Development
Total Project Budget: $1,672,089
Industry Cost Share: $501,627
DOE Cost Share: $1,170,462
Planned Project Duration: October 2002–March 2006

Contacts:

NREL/Sandia:
Alan Laxson, NREL
1617 Cole Blvd.
Golden, Colorado 80401
303-384-6944
alan_laxson@nrel.gov

Northern Power Systems, Inc.:
Jonathan Lynch, NPS
182 Mad River Park, P.O.Box 999
Waitsfield, Vermont 05673
jlynch@nothernpower.com

Current Status: Testing completed in early 2006. Preparation of final report underway.

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